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IDENTIFICATION OF ADDITIONAL ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSAS) WITHIN THE NEWFOUNDLAND AND LABRADOR SHELVES BIOREGION

Figure 1: Study area for the identification of EBSAs in the Newfoundland and Labrador Shelves Bioregion.

Context:

In support of domestic integrated management efforts, EBSAs have been identified in each of DFO's five Large Ocean Management Areas (LOMAs), including the Placentia Bay Grand Banks LOMA (Templeman 2007). Advice on the identification of additional EBSAs (see DFO 2009) that are within the larger Newfoundland and Labrador Shelves Bioregion exclusive of the Placentia Bay/Grand Banks LOMA will serve as a key component of the information necessary for i) developing Canada's network of marine protected areas (MPAs) to meet the domestic and international commitments, and ii) facilitating the implementation of DFO's Sustainable Fisheries Framework under the Fisheries Act. In addition, this information will be of direct use to other federal Departments, as well as the Government of Newfoundland and Labrador and other organizations, which are responsible for the management of activities in the Newfoundland and Labrador Shelves Bioregion within their mandate.

This Science Advisory Report is from the October 23-25, 2012 review on the Identification of Ecologically and Biologically Significant Areas (EBSAs) for the Newfoundland and Labrador Shelf Bioregion. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Canada

SUMMARY

- Fifteen EBSAs were identified, delineated and described within the Newfoundland and Labrador Shelves Bioregion study area. The 14 static EBSAs represent approximately 31% of the total area examined.
- In the Newfoundland and Labrador Shelves Bioregion study area, three EBSAs are in coastal areas (Nain Area, Lake Melville, and Gilbert Bay); seven EBSAs are in offshore areas (Outer Shelf Saglek Bank, Outer Shelf Nain Bank, Hopedale Saddle, Labrador Slope, Labrador Marginal Trough, Notre Dame Channel, and Orphan Spur); four EBSAs straddle coastal and offshore areas (Northern Labrador, Hamilton Inlet, Grey Islands, and Fogo Shelf); and one is a transitory EBSA that follows the southern extent of pack ice.
- A number of sources of information, including research survey data, published and unpublished studies, local and traditional ecological knowledge, and expert knowledge were considered for the identification of EBSAs in the study area. However, it is recognized that additional information may exist, or become available, that could potentially identify more specific areas of significance within each of the EBSAs, refine the boundaries of the EBSAs, or result in the identification of additional EBSAs.
- Much of the data available for analysis provided limited information among seasons and therefore improved information on seasonality could also enhance the identification of EBSAs.
- Dealing with information and data originating from multiple sources and various collection methods presents a challenge in combining the available material into metrics that can then be compared. To address this, coastal and offshore components of the study area were assessed separately.
- A total of 208 biological and oceanographic layers of data were examined to complete the analyses required to identify EBSAs in the study area. Ninety-nine offshore layers were resampled using a 20 km x 20 km grid; and 75 coastal layers were reviewed at the scale at which the data were available. Of these, 52 coastal layers were based on Community-based Coastal Resource Inventory (CCRI) data.
- Most EBSAs within the Newfoundland and Labrador Shelves Bioregion study area were identified based on the aggregation of one or, more frequently, several taxa in an area because few available data sets, even paired with expert knowledge, allowed for the assessment of life history events being undertaken by a species in a given area. It can be assumed however that aggregations are often linked to activities vital to fitness consequences – especially if appearing to be seasonally predictable across years.
- Post meeting it was discovered that the ArcGIS quantile classification used to complete the significant area analyses had not performed as expected. It is uncertain as to how this would have affected the final size and shape of the EBSAs as this was largely determined during the peer review process. However, the difference in the end result is likely to be insignificant as the major features of the study area are still well captured.
- It was determined that an increase or decrease in the size of the top quantile extracted as 'significant' from each layer could ultimately impact the size, but not likely the location, of the areas delineated. Notably, expert interpretation of the data layers to aid in the identification of areas also had some influence the final size and shape of the EBSAs, as did the peer review process itself.

- EBSAs have been identified only within the boundaries of the study area. However, this does not preclude the extension of the significant features that triggered the identification of EBSAs into adjacent waters.
- Many of the habitat features that underlie significant ecological and biological processes in the coastal zone were poorly resolved for this process. Such features include the extent, dynamics and duration of land fast ice coverage, the presence of polynyas and re-occurring open water leads as well as areas of high primary productivity such as kelp forests, eelgrass beds and upwelling sites.
- Deep waters, i.e., those waters off the continental shelf and slope, represent a vast expanse of ocean that remains relatively understudied and therefore undefined. Therefore, the distribution and diversity of deep-water habitats, such as abyssal plains, hydrothermal vents, methane hydrate and brine seeps, cold-water coral reefs, and deep-water canyons, and the biota they support were poorly inventoried for consideration in this type of analysis.
- Areas that were not identified as EBSAs during this evaluation still have some level of ecological importance. The distinction is that such areas may not warrant an enhanced level of protection relative to other areas, or there is not enough information currently available to identify these areas as EBSAs.
- Given the limitations of some of the available data in the bioregion, as well as changes in environmental and community structure observed in the ecosystem in recent times, it is important to revisit EBSA delineations periodically as more information becomes available from scientific research, monitoring and LEK/TEK. Such re-evaluations will ensure that management decisions are made with the best possible information.
- When determining management measures, the rationale provided for each EBSA should be carefully considered. Heterogeneity and underlying ecological properties within broadly described EBSAs need to be clearly defined with respect to the temporal and spatial extent of the layers, as well as the associated uncertainties of each.
- Prioritization of the EBSAs identified for the study area would be dependent upon objectives for management within the bioregion. As these have yet to be determined, ranking of identified EBSAs would be of no further benefit at this point in time.

BACKGROUND

Under Canada's *Oceans Act* (1997), "conservation, based on an ecosystem approach, is of fundamental importance to maintaining biological diversity and productivity in the marine environment". This Act provides the legislative framework for an integrated ecosystem-approach to management in Canadian oceans, particularly in areas considered ecologically or biologically significant. The *Oceans Act* (S35(2)) also commits Canada domestically to the development of a national network of MPAs within an integrated management planning context. Commitments for the establishment of a network of MPAs have also been made at a number of international fora, including the World Summit on Sustainable Development (WSSD, Johannesburg, South Africa, 2002), and the Convention on Biological Diversity (CBD) Conference of the Parties (COP) Decision VIII/24.

Ecologically and Biologically Significant Areas are geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics. The identification of EBSAs is not meant to be a general strategy for protecting

all habitats and marine communities; rather it is a tool to call attention to areas that have particularly high ecological or biological significance to allow appropriate management. In this regard, it is important that results of EBSA identification are communicated clearly and concisely, and that EBSAs are defined in such a manner (i.e., clearly describing individual components and their associated spatial and temporal characteristics, as well as associated uncertainties) as to support their use in policy and management decision-making.

Ecologically and Biologically Significant Areas identified within the Newfoundland and Labrador Shelves Bioregion will serve as a key component of the information necessary for i) developing Canada's network of MPAs to meet the domestic and international commitments noted above, and ii) facilitating the implementation of DFO's Sustainable Fisheries Framework under the *Fisheries Act*. In addition, this information will be of direct use to other federal Departments, as well as the Government of Newfoundland and Labrador and other organizations, who are responsible for the management of activities in the Newfoundland and Labrador Shelves Bioregion within their mandate (e.g. for resource extraction, marine shipping, ocean dumping, spill response, cable laying, coastal planning, etc.).

Ecologically and Biologically Significant Areas have already been identified in each of DFO's five Large Ocean Management Areas (LOMAs), including the Placentia Bay-Grand Banks LOMA (PBGB LOMA). Therefore, the study area for which EBSAs are currently being identified is the Newfoundland and Labrador Shelves Bioregion that is north of the PBGB LOMA. Off the northeastern coast of Newfoundland and the coast of Labrador, the study area extends eastward from the shoreline to Canada's Exclusive Economic Zone (EEZ) between 49.8°N and 61.1°N and is inclusive of the Northwest Atlantic Fisheries Organization (NAFO) divisions of 2GHJ3K.

Fisheries and Oceans Canada has provided two sources of guidance for the identification of EBSAs domestically: the first focusing on criteria for their identification (DFO 2004), and the second is based on lessons learned over the course of several years of application of those criteria to identify EBSAs within DFO's five Large Ocean Management Areas (DFO 2011a). The guidelines provided in these two documents were used to identify EBSAs within this project.

A Steering Committee, comprised of representatives from DFO Science and Oceans, was formed in June 2011 to consider the available guidance and to lead the process of data identification, collection, processing and analysis, and to delineate candidate EBSAs within the Newfoundland and Labrador Shelves bioregion study area. All available sources of information identified by the Steering Committee to be pertinent to the process were organized in a Geographic Information System (GIS) to develop spatially referenced data layers to allow for subsequent use in the identification and delineation of candidate EBSAs. As part of the peer review process, all of the data and the candidate EBSAs were presented to a group of science experts and other knowledgeable stakeholders for consideration in the determination of the final EBSAs.

ANALYSIS

Development of Spatially Referenced Data Layers

Guidance for the identification of EBSAs requires that rationale for the identification of each area be well documented. All data used in the identification and delineation of candidate EBSAs in the Newfoundland and Labrador Shelves Bioregion study area included metadata such as type, origin, scale, spatial and temporal range, as well as the methodologies used to collect the data.

Data from various sources representing biological, physical and oceanographic features were formatted for use in a GIS, ArcGIS v10.0, to store, manage, analyze, and display the spatially-referenced data. The data were processed to create spatially-referenced layers that were subsequently used to highlight the most ecologically and biologically important areas for each layer, as well as for conceptual layers (logical groupings of data layers that have common taxa/characteristics). The resulting important areas identified in the GIS analysis were then used to identify and delineate candidate EBSAs.

Data Analysis

Spatial and Temporal Extent and Sources of Data

A total of 208 layers of biological and oceanographic data were examined. The data and information layers considered included: geomorphology; oceanography; plankton; invertebrates; marine plants, fish, mammals, birds and reptiles (commercial and non-commercial and anadromous and estuarine as applicable); Scientific knowledge; and Traditional and Local Ecological Knowledge (TEK/LEK).

The key sources of biological information and data were DFO and Environment Canada (Canadian Wildlife Service, CWS). Most fish, shellfish, coral and sponge data were collected during fall (October – December) DFO multispecies (Engel[1] and Campelen[2]) or industry-led research vessel (RV) surveys. Exceptions include capelin data collected during hydroacoustic (offshore) and beach surveys; salmonids data collected at summer counting fences, offshore drift net surveys, and commercial fishing and tagging studies; and marine mammal data collected during aerial and telemetry studies, and supplemented with historical whaling and observer data. CWS migratory bird data were collected using a variety of methods (ground-based and aerial surveys, tracking studies and pelagic ship-based surveys), all with different levels of seasonal coverage. Coastal data for several taxonomic groups were supplemented by TEK/LEK collected during a Community-Based Coastal Resource Inventory project.

Several sources of data/information obtained for this process were either considered as supplementary information during the analysis or were not used at all for the determination of EBSAs in the Newfoundland and Labrador Shelves bioregion. Some of the reasons for the lack of inclusion were related to lack of relevancy for this exercise (e.g. crab trap survey data, groundfish acoustic data, turtle data, eel data); data availability (e.g. preliminary ringed seal satellite tagging data); disparity with other survey methods (e.g. not enough data points in juvenile and spawning data); and existence of effort bias in the survey method (e.g. CCRI, observer data), among others. However, key findings identified by meeting participants were included where appropriate. Important Bird Areas (IBAs) were used only to verify that most IBAs were captured within EBSAs, not to delineate them directly. Buffered seabird colonies were included in conceptual layers but were also not used to delineate EBSAs due to overlap with other similar data sources, and because many of the buffered colonies covered a large portion of the study area, making it difficult to identify significant areas. Community-based Coastal Resource Inventory data were used to identify species present within EBSAs that were identified based on scientific data.

[1] Gear type used during RV surveys 1977-1994 in NL
[2] Gear type used during RV surveys 1995-2010 in NL

Spatial Analysis

Based on the differences in scale of the available data, 100 offshore-layers were resampled to a common 20 km x 20 km grid; and 72 coastal- layers (50 based on CCRI data) were reviewed at the scale at which the data were available.

Principal Components Analysis (PCA), used to transform data and eliminate redundancy in multivariate datasets, and clustering were applied to summarize 38 layers of oceanographic and bathymetric data into a single layer for each season that identified statistically-similar oceanographic regions. The derived oceanographic data layers, while not applicable for inclusion in the final cell statistics analysis (see below), provided valuable supporting information during the EBSA delineation exercise.

Spatial interpolation techniques were used to create rasters to identify the highest density areas within each data layer. A quantile classification was applied to each density surface where the uppermost class (i.e. quantile) represented the areas of highest concentration and was considered to be important for a particular species. These areas of importance were extracted and converted to polygons for each data layer. Species or subject-matter experts also reviewed the data layers and provided advice on potential outliers or omissions in the data.

In order to apply an equal weighting for each layer, all significant-area polygon layers were assigned a value of one. Using the offshore data, conceptual layers were created by grouping data with similar characteristics where the individual layers within each group were overlaid and summed to identify areas of cumulative significance. Resulting conceptual layers included those for marine mammals, birds, corals and sponges, core fish species[3], fish functional groups, rare or endangered fish species, and juvenile and spawning fish. An overall composite layer was also created for the offshore by overlaying and summing all of the conceptual layers.

The Steering Committee used the composite layer as the basis for the initial identification and delineation of candidate EBSAs based on species aggregation in the offshore. An in-depth review of each conceptual layer and its corresponding individual layers was conducted to ensure that other EBSA criteria, such as unique features or areas of important fitness consequences, were included in the identification of candidate EBSAs. The candidate EBSAs and rationale for their identification were presented for peer review at the October Canadian Science Advisory Secretariat (CSAS) meeting, at which time the final EBSAs were agreed upon and delineated. Meeting participants included DFO scientists, academia, other government organizations and knowledgeable stakeholders.

Coastal data layers were not included in this offshore composite layer because the scale of these data was not comparable with those of the offshore. Coastal EBSAs were identified using expert knowledge and a fine-scale visual review of all available data by the Steering Committee and during the peer review process.

The caveats associated with the use of the various analytical techniques, included in the detailed methodology, are not seen as major limitations to the analysis. Particularly regarding decision-rules, use of the upper class in a quantile classification system is considered reasonable for highlighting areas of significant density; however this value remains somewhat arbitrary and maintains the potential to omit or over-represent important areas, depending on species.

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[3] Core fish species are those that exhibit high dominance in the fish community and have important roles in the food web and are, or have been, commercially relevant. They include American plaice, Atlantic cod, Capelin, Greenland halibut, Redfish, Witch flounder, Crab and Shrimp.

It was determined that an increase or decrease in the size of the top quantile extracted as 'significant' from each layer could ultimately impact the size, but not likely the location, of the areas delineated. This is particularly true for EBSAs defined mainly using the aggregation criterion, as these EBSAs were mainly identified based on an accumulation of species occurring in the area. Therefore, if the size of the top quantile extracted for areas of highest densities was increased for each individual species or taxonomic group, the resulting EBSA would likely see an increase in the boundary. Notably, expert interpretation of the data layers to aid in the identification of areas also had some influence on the final size and shape of the EBSAs, as did the peer review process itself.

Identification and Delineation of Ecologically and Biologically Significant Areas

DFO has developed criteria to differentiate areas which are "particularly important" or "significant" with regard to specific ecosystem structural or functional properties. Three main criteria under which specific areas can be evaluated with regard to their ecological and biological significance, uniqueness, aggregation, and fitness consequences, were considered for their occurrence within the study area to facilitate the identification and delineation of candidate EBSAs. Additional secondary criteria, naturalness and resiliency, were not directly considered during the identification process, but were discussed during the application of the primary criteria.

Seventeen candidate EBSAs were identified in the study area by the Steering Committee and proposed for the peer review process. During the peer review, three of these areas were rejected; two of these areas were merged to become one; and two new areas were proposed and accepted.

Fifteen EBSAs were ultimately identified and delineated in the study area (see Figure 2 and Appendix A): three in coastal areas (Nain Area, Lake Melville, and Gilbert Bay); seven in offshore areas (Outer Shelf Saglek Bank, Outer Shelf Nain Bank, Hopedale Saddle, Labrador Slope, Labrador Marginal Trough, Notre Dame Channel, and Orphan Spur); four spanning coastal and offshore areas (Northern Labrador, Hamilton Inlet, Grey Islands, and Fogo Shelf); and one transitory EBSA that encompasses the southern extent of pack ice. The static (i.e. spatially defined) EBSAs represent approximately 31% coverage within the study area.

The following descriptions clearly indicate the dominant significant features leading to the identification of the 15 EBSAs; as well as other important attributes that were noted to occur in the area.

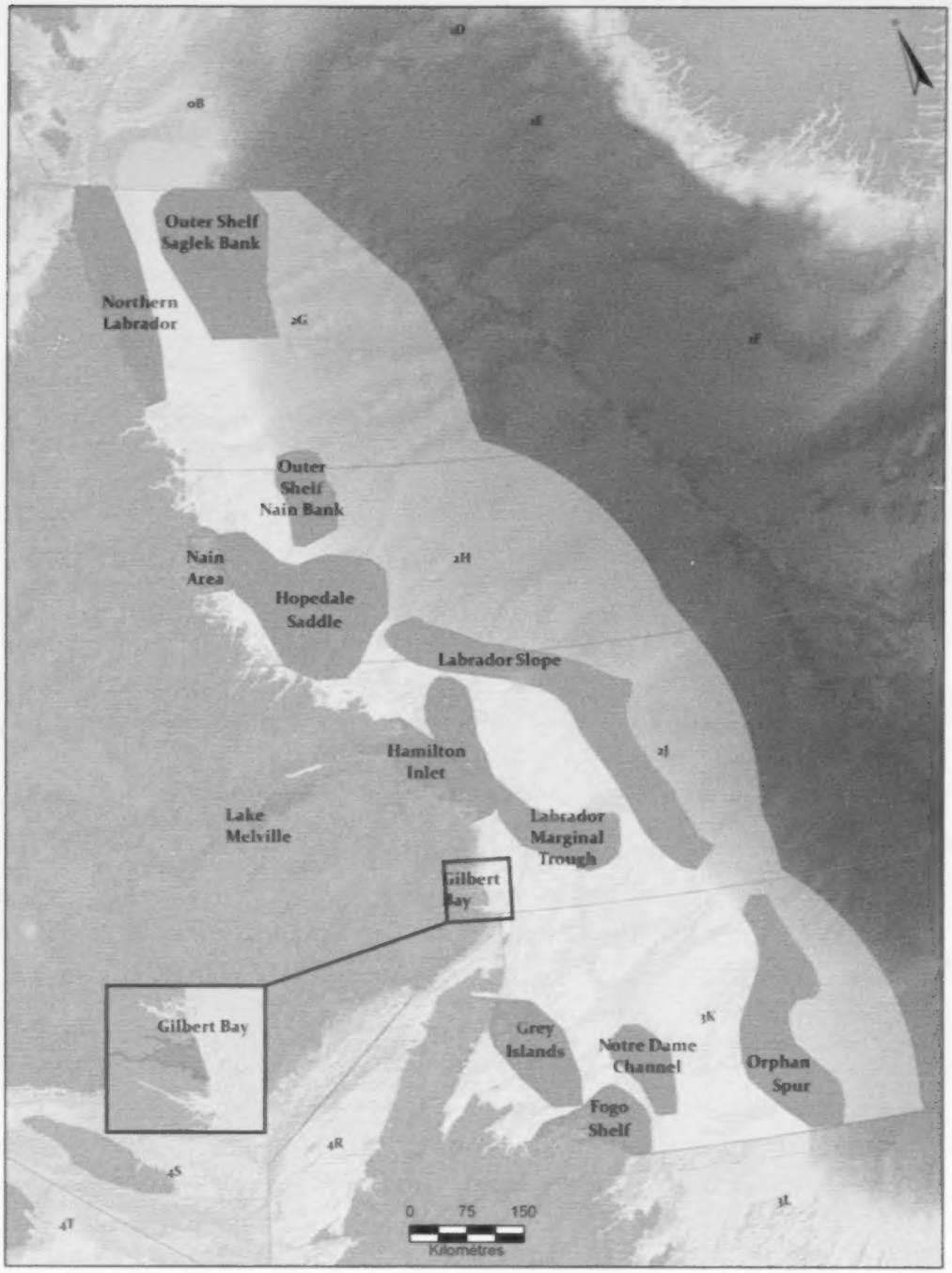


Figure 2: The 14 static EBSAs identified and delineated in the Newfoundland and Labrador Shelves Bioregion study area.

Coastal EBSAs

Three EBSAs were identified in coastal areas. The dominant data layers identifying these areas included those for salmonids, capelin spawning, seabirds and waterfowl. A review of CCRI data also confirmed the presence of other species in these areas.

Nain Area

The Nain Area EBSA includes five bays (Webb Bay, Tikkoatokak Bay, Nain Bay, Anaktalik Bay and Voisey's Bay) that converge in an area along the Labrador coastline, and is the drainage basin for the Fraser River.

The dominant data layers identifying this EBSA include those for several species of waterfowl and seabirds, as well as capelin. A number of seabird and Common Eider colonies occur in the area, including an important Thick-billed Murre colony. A capelin spawning beach was identified here based on both scientific data and TEK. Nain Bay and surrounding areas are also noted to be highly productive for Arctic Charr, contributing significantly to juvenile rearing, as well as juvenile and adult feeding.

Peer review participants identified several aspects of the land fast ice habitat in the Nain area as being relatively unique and important to overall productivity of the EBSA. The many coastal islands anchor and protect the land fast ice from excessive compression by pack ice while the pack ice itself protects the coast from winter and early spring storm surges. This land fast ice habitat is an important overwintering and breeding area for ringed seals and is particularly important for polar bears, wolves, foxes and ravens that hunt or scavenge on seals that use the habitat. The land fast ice also provides a migration or seasonal travel corridor for several species including terrestrial predators and caribou. Geomorphological features, known as boulder flats and boulder barricades, are also common in this area and are a result of ice transporting boulders from the shore into the intertidal zone. Voisey's Bay also has the largest sand delta in the area, which is an important feature for seabirds. A population of spawning salmon occurs here, as well as some of the largest Glaucous Gull congregations.

Community-based Coastal Resource Inventory data identified a number of areas where aggregations of groundfish, pelagic fish, shellfish, marine mammals and aquatic plants occur within the boundaries of this EBSA.

Lake Melville

Lake Melville is a saltwater tidal extension of Hamilton Inlet and one of the largest fjords in eastern Canada (3069 km^2). It extends inland approximately 130 km from Hamilton Inlet and is characterized by two basins, Goose Bay and Lake Melville proper. Goose Bay has a maximum depth of 55 m and Lake Melville has a maximum depth of about 220 m. The Churchill River drains much of the Labrador plateau and provides 75% of the freshwater input to Lake Melville through Goose Bay. The marine influence is also strong in this system and brackish waters occur all the way up the braided Churchill River channel above Mud Lake at the inflow to the estuary. The EBSA encompasses the entire Lake Melville area and also includes the narrows leading into Double Mer as well as the narrows surrounding Henrietta Island and The Backway. The outer boundary occurs just outside Rigolet at the narrows leading into Hamilton Inlet, and meets the inner boundary for the Hamilton Inlet EBSA. Double Mer was not included as this is a freshwater lake.

All of the significant features of this area were highlighted by experts during the peer review meeting. The brackish waters of Lake Melville represent a unique habitat within the study area.

Productivity and species diversity are notably high in Lake Melville; and this area is also the northern most distribution of many of the species occurring there.

The dynamic nature of Lake Melville, along with being located at the juxtaposition of several biogeographic boundaries, contributes to the diversity of fish species occurring there. This includes various freshwater species found in the upper, brackish areas of the fiord (e.g., Lake Whitefish, White and Longnose Suckers), diadromous species such as Brook Trout and Rainbow Smelt that feed extensively within the fiord; as well as a variety of marine species including Thorny Skate, Atlantic Tomcod, Laval's Eelpout, Arctic Eelpout, Sculpin, Atlantic Sturgeon, among others. The area is also an important area for sea run trout and Atlantic Salmon, as several spawning rivers and juvenile rearing areas occur there. The Backway, at the eastern end of Lake Melville, is unique for the Surf Scoter as the highest counts of moulting individuals of this species in eastern Canada have occurred there. The eastern portion of the Lake is an important overwintering and breeding area for ringed seals resulting in particularly high winter and early spring densities in the area. There is also a resident population of harbour seals in the Lake while a number of other marine mammals (e.g. Minke Whales, Humpback Whales, various dolphin species, Harp Seals) feed in the area.

Lake Melville also contributes significantly to the productivity of the adjacent Hamilton Inlet as well as the Labrador shelf south of its outflow by contributing inorganic nutrients to the spring bloom communities of the shelf. It is also worth noting that polynyas form in the Narrows and in other isolated areas within this EBSA.

Gilbert Bay

Gilbert Bay, located on the southeast coast of Labrador, is a shallow-water, low-gradient, sub-arctic fjord composed of a series of basins separated by sills that become shallower towards the head. The bay is 28 km long and is less than 4 km at its widest point, covering approximately 60 km^2. The Gilbert Bay EBSA extends from the head of Gilbert Bay out to the headlands of Salmon Point to the north. The EBSA also includes Alexis Bay and surrounding coastal areas to Spear Point in the south, as all of these areas are considered to be important Gilbert Bay cod habitat. A marine protected area (MPA) has been established in Gilbert Bay since 2005.

Peer review participants highlighted some unique features of this area including the geomorphology and hydrography which influence the ecology of the species in the area, including a genetically distinct resident population of Atlantic Cod. Other species that are important in the Gilbert Bay area include Arctic Charr and Atlantic Salmon. Capelin are also extremely important to the local ecology and are known to spawn in the area.

Coastal and Offshore EBSAs

Four EBSAs were identified based on a combination of coastal and offshore data, and therefore straddle coastal and offshore areas. The dominant layers identifying these areas were those for salmonids, capelin spawning, corals and sponges, rare or endangered fish species, core fish species, functional groups of fish, marine mammals, seabirds and waterfowl.

Northern Labrador

The Northern Labrador EBSA extends from Cape Chidley to just south of Saglek Bay along the coast, and offshore to include part of Saglek Bank.

This EBSA was mainly identified as an important migratory area for the endangered Eastern Hudson Bay Beluga, as well as important coastal areas for *Species at Risk Act* (SARA) listed

waterfowl. Harlequin Duck and Barrow's Goldeneye (species of 'Special Concern' under *SARA*) occur in relatively high densities in the fjords in this area.

Other species occur in this area in high concentrations, but not are necessarily key to identification of the EBSA. Common Eider occurs here in high concentrations during winter months, while important Black Guillemot and Glaucous Gull colonies are also located here. High densities of other seabirds (Black-legged Kittiwake, murres, Northern Fulmar, skuas and jaegers) were found during pelagic surveys in the area. Medium benthivores and plankpiscivores were common during the Engel period.

Peer review participants highlighted some other important features of this area including increasingly important summer and early fall polar bear habitat that provides both nearshore feeding opportunities as well as a migration corridor. The coastal area was also noted for significant summer feeding and haul out activity of ringed seals which are the main prey of polar bears frequenting the area at that time of year. The area also features aggregations of birds (e.g. Glaucous Gull, Common Eider) and is an important rearing and feeding area for Arctic Charr.

Hamilton Inlet

The Hamilton Inlet EBSA includes the coastal and inner shelf area (approximately out to the 200 m isobath) outside of Hamilton Inlet, Sandwich Bay and south to Black Tickle-Domino on Island of Ponds. This EBSA is adjacent to the Lake Melville EBSA to the west and the Labrador Marginal Trough EBSA to the east but was kept separate because of the differences in habitat type and key features identified.

The dominant data layers identifying this EBSA include those for Capelin, Atlantic Salmon and seabirds. Several Capelin spawning beaches occur at the southern end of the EBSA, while Paradise River, Eagle River, White Bear and North Rivers (Sandwich Bay area) are highly productive for Atlantic Salmon. The coastal area outside of Sandwich Bay was identified as having the highest density of Atlantic Salmon in the Newfoundland and Labrador shelf area during summer drift net surveys (1965-2001). While several bird species are found here in high concentrations, it should be noted that two of the three highest density Atlantic puffin colonies, and all four of the highest density Razorbill colonies that occur in the study area are found within this EBSA.

Peer review participants highlighted features of this area that enhance overall productivity. The EBSA occurs at the outflow of Lake Melville, which drains most of the Labrador plateau and provides nutrients that are critical to initiate primary productivity blooms along the Labrador coast. Polynyas, large and productive areas of open water surrounded by sea ice, also form in this EBSA annually.

Traditionally, the main Harp Seal whelping concentration usually forms on the pack ice in this EBSA. The western portion of Inlet is an important fall and early winter feeding area for ringed seals. The area also is important for several waterfowl species (dabbling ducks, geese and sea ducks, including Common Eider). Colonies of great Black-Backed Gull, Herring Gull and Northern Fulmars also occur in the area. High concentrations of many seabird species (Atlantic Puffin, murres, Northern Gannet, Razorbill, Dovekie, skuas and jaegers, and Sooty Shearwater) and Harlequin Duck (species of 'Special Concern' under *SARA*) occur within this EBSA. Community-based Coastal Resource Inventory also identified high densities of many species in several areas this EBSA.

Grey Islands

The Grey Islands EBSA, located east of the Northern Peninsula on the island of Newfoundland, includes the coastal areas surrounding the Grey Islands and extends inshore to include part of Hare Bay and southeast along the inner shelf towards Fogo Island. The southern boundary is adjacent to the Fogo Shelf EBSA.

The dominant data identifying this EBSA include those for waterfowl and seabirds in coastal areas; as well as those for seabirds on the shelf. Along the coast, sea ducks, specifically Common Eider and the Harlequin Duck (species of 'Special Concern' under *SARA*) occur in high concentrations. The Great Black-backed Gull, Herring Gull and terns also have important breeding colonies in this area. A high diversity of seabird species (e.g. Common Murre, Black-legged Kittiwake, Dovekies, Great Black-backed Gull, Greater Shearwater, Herring Gull, murres, Northern Fulmar, Northern Gannet, phalaropes, Atlantic Puffin, skuas and jaegers, Sooty Shearwater, storm petrels and terns) also aggregate along the inner shelf area within this EBSA and may be considered an indication of high, year-round, productivity in that area. The Grey Islands area also corresponds with previously identified IBAs.

In the inner shelf area, Soft Corals and Small Gorgonians are found in high concentrations, while capelin were found in aggregations here during the Campelen period. Community-based Coastal Resource Inventory data also identified small distinct areas within this EBSA where groundfish, pelagic fish and shellfish are known to occur.

Fogo Shelf

The Fogo Shelf EBSA extends from the headlands at the western entrance of the Bay of Exploits and approximately follows the 200 m isobath eastward to the study area boundary near Cape Freels. It includes the larger islands such as Twillingate Island, New World Island and Fogo Island, as well as many smaller islands in the Bay of Exploits and Gander Bay areas. The ecological importance of this area, especially related to productivity, likely extends south of the study area boundary into NAFO Division 3L.This is evident based on the previous identification of an IBA that extends along the coast from just north of Cape Freels south to the headlands outside of Indian Bay.

The dominant data layers identifying this EBSA include those for Capelin, Atlantic Salmon and several waterfowl and seabird species.

The coastal area of this EBSA is noted for an abundance of beach and sub-tidal capelin spawning areas, with the greatest concentrations on North Twillingate Island and along the coast west of Cape Freels. The Bay of Exploits area is very important for Atlantic Salmon, with the highest total returns of all monitored rivers in the study area concentrated in this area. The Gander Bay area, fed by the Gander River, is the second most productive salmon river on the island within the study area; hundreds of thousands of salmon smolts migrate into these nearshore areas and feed before moving out into the north Atlantic. Much of the mortality impacting salmon is believed to occur during the time when smolts first enter the marine environment and so coastal areas are very important to the subsequent survival of salmon smolts. They are also important migration and feeding areas for returning adult salmon including kelt (previous spawners).

The shelf area of this EBSA includes Funk Island, an ecological reserve home to the largest Common Murre colony in the western North Atlantic and the only Northern Gannet breeding colony in the bioregion study area. Other bird species that aggregate in high concentrations throughout this EBSA include sea ducks, specifically Common Eider, Atlantic Puffin, Great

Black-backed Gull, Greater Shearwater, Herring Gull, Northern Fulmar, Thick-billed Murre and terns. Important cetacean feeding areas have also been identified in this area.

Small benthivores occurred in high densities on the shelf area of this EBSA during the Campelen period. Community-based Coastal Resource Inventory data identified several areas where groundfish, pelagic fish, shellfish, aquatic plants and marine mammals are present within this EBSA.

Offshore EBSAs

Eight EBSAs were identified in the offshore portion of the study area, including one EBSA based on the southern extent of pack ice. The dominant layers identifying these areas were generally those for corals and sponges, rare or endangered fish species, core fish species, fish functional groups, marine mammals and seabirds.

Notably, in the offshore, the entire Labrador shelf edge and slope was highlighted through a combination of data and expert knowledge to be ecologically important based on its high productivity and diversity relative to the shelf. However, the entire area was not delineated as an EBSA to reduce the risk of minimizing the enhanced significance of specific areas within. The most significant areas of aggregation were often associated with areas of unique bathymetry, such as banks, troughs and spurs.

Outer Shelf Saglek Bank

The Outer Shelf Saglek Bank EBSA includes the outside edge of Saglek Bank as well as northern parts of the outer shelf and Labrador Slope which extend beyond Saglek Bank. The northern boundary for this EBSA is the study area boundary itself. While the boundaries are based on species aggregations, this EBSA generally extends from the 200 – 2000 m isobaths.

The dominant data layers identifying this EBSA include those for corals, sponges, marine mammals, and seabirds. Sea pen concentrations exist in the northwestern portion of this EBSA, while significant concentrations of small gorgonian corals and sponges are found along the slope. Various species of marine mammals frequently aggregate throughout this EBSA – harp and hooded seals feed here extensively during the summer; and several species of whales, including Northern bottlenose and sperm whales, migrate through, and feed, in the area. The Ivory Gull, listed as endangered under *SARA*, is also found in high concentrations throughout much of this EBSA.

The Outer Shelf Saglek Bank area was also noted as being important for several other species of seabirds – evidence has shown that high densities of skuas and jaegers, phalaropes, Northern Fulmar, murres, Greater Shearwater, Dovekie, and Black-legged Kittiwakes can occur here.

Roundnose Grenadier, which was designated as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), was found in significant concentrations near the north end of the Labrador Slope during the Engel period.

Notably, this EBSA overlaps with the southward extension of another EBSA that was identified north of the study area boundary during a similar EBSA exercise in the Central and Arctic Region. This area was identified for having high benthic diversity, high biological productivity and several rare or endangered species (DFO 2011b).

Outer Shelf Nain Bank

The Outer Shelf Nain Bank EBSA includes the outer shelf and Labrador Slope area (from approximately the 200 m to the 2000 m bathymetric contour) adjacent to Nain Bank.

The dominant data layers identifying this EBSA include those for various corals, fish, marine mammals and seabirds. In general, the area is high in diversity. Black corals and stony cup corals occur in high concentrations near the south end of this EBSA. High concentrations of various fish species, including small and medium benthivores, as well as planktivores, occur throughout. Hooded Seals frequent the area for feeding – juveniles from August to February; and adult females year round. Several seabird species also aggregate here, including Black-legged Kittiwake, Dovekie, phalaropes, skuas and jaegers, terns and the Ivory Gull. Thick-billed Murre also use the area during the spring.

Hopedale Saddle

The Hopedale Saddle EBSA includes the inner shelf and Labrador Marginal Trough adjacent to the Nain Area EBSA and extends southward to include the northern part of Makkovik Bank. The eastern portion of the EBSA includes the high point of Nain Bank at the north end and extends offshore to include the Hopedale Saddle.

The key feature used to identify this EBSA is that it is a unique overwintering area for the endangered population of Eastern Hudson Bay Beluga. Satellite tagging data have indicated beluga diving activity in this area which suggests repeated movement between partially ice-covered sea surface habitats and warmer, deep-sea areas. Such activity may be associated with foraging.

Several other coral, fish and seabird species, including many that are rare or endangered (e.g., Skates, Atlantic and Spotted Wolffish, Roundnose Grenadier, Ivory Gull), are found in high densities throughout parts of this EBSA.

Also abundant in the area are sea pens, soft corals and small gorgonians, with sea pens occurring in higher concentrations near the 400 m isobath and other coral species occurring in deeper waters at the offshore edge of the EBSA. Shrimp, Greenland Halibut, Redfish, plankpiscivores, planktivores, piscivores, and small and medium benthivores were also found here in high concentrations during the Campelen period. Several species of seabirds were found here in high densities during pelagic surveys (Black-legged Kittiwake, Dovekie, Greater Shearwater, murres, Northern Fulmar, phalaropes, Atlantic Puffin, Razorbill, skuas and jaegers, Sooty Shearwater and terns) and the outer boundary was extended slightly northward to include an area where the endangered Ivory Gull was found in high densities (in addition to Black-legged Kittiwake, Dovekie and phalaropes).

Labrador Slope

The Labrador Slope EBSA generally includes the slope from the 400 m to 2000 m isobath and extends from the outer edge of Makkovik Bank, southward along the slope to the outer edge of Belle Isle Bank.

The dominant features used to identify this EBSA include corals, sponges, rare or endangered species, core species, and fish functional groups. In general, the area is high in diversity. Corals and sponges are concentrated in various areas throughout the EBSA - soft corals in the north and south, black corals in the north, and sponges centrally near Hamilton Spur. Several rare or endangered species, including Atlantic, Spotted and Northern Wolffish, Roundnose Grenadier and skates have significant concentrations within the area; as do species such as Northern

Shrimp, Greenland Halibut, Redfish, Atlantic Cod and American Plaice. All fish functional groups also occur in high densities along the Labrador Slope.

Peer review participants highlighted that species of corals other than those identified in the data layers have been noted to occur in high concentrations along the entire slope edge. Also, juvenile and female hooded Seals, as well as a variety of cetaceans and seabirds (e.g. Black-legged Kittiwake, Dovekie, Great Black-backed Gull, Greater Shearwater, Sooty Shearwater, Northern Fulmar, skuas and jaegers and phalaropes), frequent the Labrador Slope area in high relative numbers for feeding.

Labrador Marginal Trough

The Labrador Marginal Trough EBSA extends from the Cartwright Saddle south through the Labrador Marginal Trough and into the Hawke Saddle, just inside Hamilton Bank.

The dominant data layers identifying this EBSA include those for several core fish species and various marine mammals. Shrimp, Snow Crab, Greenland Halibut, American Plaice, Witch Flounder and Capelin currently occur in high densities at the north and south ends of this EBSA. The middle portion of this area (trough area) is a potential corridor for several species of fish and mammals and includes part of the area of highest probability of use for harp seal whelping and feeding.

Aggregations of plankpiscivores (in the north and south ends), small benthivores (in the south end), and medium benthivores (along the edges of Hamilton bank extending into the area) also occur or have been known to occur in this EBSA. Cetaceans aggregate in this area for feeding during the fall – but also frequent Hamilton Bank and out to the Labrador Slope at the same time. Finally, this area was also important for several species of seabirds, including murres, Black-legged Kittiwake, Great Black-backed Gull, Herring Gull, Northern Fulmar, Atlantic Puffin, skuas and jaegers, Sooty Shearwater, and the endangered Ivory Gull.

Notre Dame Channel

The Notre Dame Channel EBSA is part of a larger channel that extends offshore from Notre Dame Bay out towards the Labrador Slope, and branches southward along the inner edge of Funk Island Bank. This EBSA includes only the southeast branch of the Channel between the Fogo Shelf area and Funk Island Bank.

The high diversity of this EBSA was highlighted within the composite layer (i.e. it represented significance for multiple species). Other dominant data layers in this EBSA include those for cetaceans, skates, and several core fish species. The area is significant for cetacean feeding and migration. Skates (including Smooth Skate and the Thorny Skate, designated as endangered and special concern by COSEWIC, respectively) occur in high densities throughout the area. Significant aggregations of Capelin, American Plaice, Greenland Halibut, Snow Crab and Shrimp currently exist in this EBSA; while Witch Flounder, Redfish, and Greenland Halibut were noted to occur here in high concentrations during the (earlier) Engel period.

This EBSA is also frequented by several species of seabirds, including Common Murre, Thick-billed Murre, Black-legged Kittiwake, Great Black-backed Gulls, Northern Fulmar, phalaropes, skuas and jaegers, Sooty Shearwater and storm petrels. Harp seals are known to feed in this and surrounding areas during winter months.

Orphan Spur

The Orphan Spur EBSA encompasses a large area that extends along the Labrador Slope and Outer Shelf in NAFO Division 3K, and includes the Orphan Spur and part of the Trinity Trough Mouth Fan. The northern portion of the EBSA extends from 400 m to 2000 m depth, although south of the Orphan Spur the maximum depth is approximately 1000 m.

Similar to the Labrador Slope EBSA, this area is high in diversity as a number of species are found here in high concentrations. The dominant data layers identifying this EBSA were those for corals, fish, marine mammals and seabirds, including rare or endangered species. During the Campelen period, high densities of Witch Flounder, American Plaice, Atlantic Cod and Redfish were distributed throughout the EBSA. Several rare or endangered fish species (Spotted, Northern and Atlantic Wolffish, Skates and Roundnose Grenadier) were found throughout this EBSA in large concentrations during the Campelen period, with the Wolffish species heavily influencing the demarcation of the southwestern boundary. With the exception of Planktivores and PlankPiscivores, many of the fish functional groups were abundant throughout this EBSA during both Campelen and Engel periods. Several marine mammal and seabird species (e.g., Thick-billed Murre, storm petrels, Black-legged Kittiwake, skuas and jaegers, Northern Fulmar, Greater Shearwater, Dovekie) also frequent this area.

Bycatch data have shown that this area seems to be important to several species of sharks.

Peer review participants identified that coral bycatch has been recorded to 1300 m depth, and the Orphan Basin area to the east of this EBSA is known to be important for a diverse array of marine birds and other taxa. Although similar habitat types would be expected in the Orphan Basin based on the geomorphology of the area, data are generally limited beyond 1000 m. Therefore further exploration into the ecological significance of this area is highly recommended if management action is contemplated.

Southern Pack Ice

Seasonal pack ice is a unique feature of the entire bioregion. Although ice provides an important habitat for a number of species throughout the Newfoundland Shelf, the southern portion of the pack ice is particularly significant. The development and recession of the ice in this region influences a variety of important environmental and biological processes including changes in light penetration, wind driven mixing, salinity, and the timing and extent of the spring phytoplankton bloom. The extent of ice and time of retreat has also been shown to influence the population dynamics of capelin.

The southern part of the pack ice is the location of the main pupping concentrations of both harp and hooded seals. Both species rely upon suitable ice extent and thickness to give birth and nurse their pups. Currently, ~70% of all harp seals and >90% of hooded seals give birth in the area although the proportions will likely increase if ice conditions in the Gulf of St. Lawrence continue to deteriorate.

The large concentration of seals using this area provides the basis for a complex ecosystem that includes a variety of marine scavengers, seabirds, including the Ivory Gull, and polar bears. The bears travel to the area from northern Labrador and Baffin Island to feed intensively during March. The energy gained off southern Labrador maintains them for much of the year.

Unlike other EBSAs, the location of the southern pack ice is transitory and varies both within and among years, as it is influenced by winds and currents. However, it usually located south of Hamilton Inlet, as far south as Notre Dame Bay. Although it cannot be defined by rigid

boundaries, the southern pack ice is an area that is highly productive and ecologically important within the Newfoundland shelf ecosystem and the North Atlantic.

Sources of Uncertainties

Sources of uncertainty in the methods used to determine EBSAs and limitations to identifying additional ecologically important areas are discussed throughout this document.

CONCLUSIONS AND ADVICE

Vast amounts of information, including biological data from research surveys, published and unpublished studies, local and traditional ecological knowledge, and expert opinion, were considered for the identification of EBSAs in the Newfoundland and Labrador Shelves Bioregion study area. A separation of the study area into coastal and offshore regions was necessary in order to combine this available material into like metrics for analysis.

Through application of DFO EBSA criteria a total of 15 EBSAs were identified, delineated and described for the Newfoundland and Labrador Shelves Bioregion study area. These include three EBSAs in coastal areas (Nain Area, Lake Melville, and Gilbert Bay); seven EBSAs in offshore areas (Outer Shelf Saglek Bank, Outer Shelf Nain Bank, Hopedale Saddle, Labrador Slope, Labrador Marginal Trough, Notre Dame Channel, and Orphan Spur); four EBSAs straddling coastal and offshore areas (Northern Labrador, Hamilton Inlet, Grey Islands, and Fogo Shelf); and an additional EBSA following the southern extent of pack ice. The 14 static EBSAs represent approximately 31% coverage within the study area.

While it was requested that Science prioritize the identified EBSAs based on levels of biological and ecological significance in the ecosystem, it was determined that this would be dependent upon objectives for management within the bioregion, and therefore, was determined to be of no further benefit at this point in time.

Most EBSAs within the Newfoundland and Labrador Shelves Bioregion study area were identified based on the aggregation criterion since few available data sets, even paired with expert opinion, allowed for the interpretation of life history activities being undertaken by a species in a given area. It can be assumed however that aggregations are often linked to activities vital to fitness consequences – especially if appearing to be seasonally predictable across years. This is particularly true for species that are considered rare or endangered.

EBSAs were only identified within the boundaries of the study area. However, this does not preclude the extension of the significant features that triggered the identification of EBSAs into adjacent waters. At the same time, areas that were not identified as EBSAs during this evaluation still have some level of ecological importance. The distinction is that such areas may not warrant an enhanced level of protection relative to other areas, or there is not enough information currently available to identify these areas as EBSAs.

It was determined that an increase or decrease in the size of the top quantile extracted as 'significant' from each layer could ultimately impact the size, but not likely the location, of the areas delineated. Notably, expert interpretation of the data layers to aid in the identification of areas also had some influence the final size and shape of the EBSAs, as did the peer review process itself. Therefore, there is a relatively high degree of confidence that the EBSAs identified contain ecologically and/or biologically significant features.

It is recognized that additional information may exist currently, or in the future, that could potentially identify more specific areas of significance within each of the EBSAs, refine the boundaries of the EBSAs, or result in the identification of additional EBSAs. Changes in

environmental and community structure observed in recent times provides additional support for revisiting EBSA delineations periodically as more information becomes available from scientific research, monitoring and LEK/TEK. Such re-evaluations will ensure that management decisions are made with the best possible information.

Much of the data available for analysis in this exercise provided limited information among seasons (i.e. was not year-round or was collected in a temporally systematic manner), which could account for patterns in intra-annual variability and/or control for potential seasonal bias associated with the data sources considered. Therefore, improved information on seasonality could also enhance the identification of EBSAs. At the same time, many of the habitat features that underlie significant ecological and biological processes, in the coastal zone (e.g., polynyas, extent and duration of landfast ice and areas of high primary productivity such as kelp forests, eelgrass beds and upwelling sites) were poorly resolved for this process. Similarly, deep waters off the continental shelf and slope represent a vast expanse of ocean that remains relatively understudied and, as a result, undefined.

Ensuring that management decisions are made with the best possible information will require consideration of the rationale provided for each EBSA. Heterogeneity and underlying ecological properties (e.g., seasonal features) within broadly described EBSAs need to be clearly identified with respect to the temporal and spatial extent of the layers, as well as the associated uncertainties of each.

The results of this EBSA exercise build on a separate process that identified EBSAs in the southern portion of the bioregion, i.e., the Placentia Bay/Grand Banks Large Ocean Management Area in 2007. EBSAs from both exercises will therefore serve as the knowledge base for making sound management decisions in marine waters adjacent to Newfoundland and Labrador.

The study area also borders on areas that were examined during the Gulf of St. Lawrence and Arctic EBSA processes. Connectivity among marine regions should be examined when considering activities within these areas.

It is noted that earlier EBSA identification processes did not benefit from some of the considerations that were provided via recent advice regarding lessons learned in past application of EBSA criteria, or that emerged as important in the application of EBSA criteria for this particular exercise. Therefore, it may be timely to review the earlier conclusions about EBSAs in the Placentia Bay/Grand Banks LOMA in light of these further developments and potential new knowledge available since their identification.

OTHER CONSIDERATIONS

Quantile Classification Issues

Post meeting it was discovered that the ArcGIS quantile classification used to complete the significant area analyses had not performed as expected. A determination of the impact of this error on the methodology for determining EBSAs was required before finalizing the science advice.

ArcGIS quantile classification is designed to identify class breaks within a dataset such that each class contains an equal number of features. Each of the layers in the analysis was classified into 10 quantiles where each class was thought to have contained an approximately equal number of raster cells. The highest class in each layer was believed to have represented

cell values above the upper 10th percentile (i.e. top decile) of the data and subsequently used to identify 'significant' areas.

A post meeting re-analysis of the classified density surfaces determined that there was an uneven distribution of raster cells in each of the 10 quantile classes with a disproportionately large number of cells in the lowest quantile class owing to problems in the software.

The effect of this misclassification was an underestimation of the areas presented as the upper 10th percentile for many of the data layers used in the analysis. Seabird data layers were not affected by the misclassification. ESRI, the manufacturer of the ArcGIS software, was approached about this issue, at which point it was identified as a software bug that the company is currently reviewing.

The severity of this issue varied between the layers where the upper quantiles presented and considered for various layers actually contained between 3.01 and 8.97 percent of raster cell values (as opposed to the full 10%), with the exception of planktivore and plankpiscivore functional groups during the Engel period (0.5 and 0.54 percent respectively), and large gorgonian corals (1.35 percent). Notably, planktivores/plankpiscivores during the Engel timeframe were not defining elements for any EBSA, and therefore do not raise significant concern. A re-analysis of the significant areas for large gorgonians revealed that 3 out of the 4 areas that were in the upper tenth percentile were already captured by one of the EBSAs.

It is unclear as to how this issue with quantile classification would have affected the final size and shape of the EBSAs as this was largely determined during the peer review process. However, the difference in the end result is likely to be insignificant as the major features of the study area are still well captured. It is recognized that the areas of highest concentration for each data layer may have been underestimated with the original intended methodology, however, the total area covered by the EBSAs still represents >30% of the study area, which is comparable to the total area covered by EBSAs in other DFO Regions.

Following on best practice, should the decision be made to establish particular management measures for any of these EBSAs, the data remains available for re-examination at the scale of that particular EBSA, minimizing further any variability between expected and real results of the analysis undertaken here.

Limitations of the Data

The Newfoundland and Labrador Shelves bioregion is data rich in many regards, but data are also limited in some aspects relative to the area considered (e.g. temporally and spatially uneven survey coverage occurs across the area). Dealing with information and data originating from multiple sources and various collection methods presented challenges in several regards. For example, the inability to combine all information so that it could be compared equally required that the assessment of the study area be largely separated into coastal and offshore regions. At the same time, layers with limited observations could not be assessed with any level of certainty (e.g. juvenile and spawning layers). Finally, the data associated with many layers provided limited information among seasons (e.g., a large proportion of the layers, specifically fish species, are derived from fall survey data). Thus, improved information on any of these aspects could enhance the identification of EBSAs.

In the coastal zone, the habitat features that underlie the significant ecological and biological processes are poorly resolved at the scale of the analysis. Many of these features are related to the seasonal presence of land fast ice including the extent and duration of ice coverage, the dynamics of ice formation and break-up and the presence of polynyas and re-occurring open water leads. Other important features include areas of high primary productivity such as kelp

forests, eel grass beds and upwelling sites. These are often determined by physical characteristics of coastal topography, bathymetry, hydrography, geomorphology, wind fields and the movement and scour depth of both pack and land fast ice. Estuarine and fjord habitats that characterize the coastline are also underrepresented in this regard.

Approaches to resolve these habitat features for further EBSA determinations could include habitat modelling based on existing data on the relevant physical characteristics of the coastal zone, the spatial analysis of bird survey data for species with specific habitat requirements, and the use of the CCRI data to locate areas of high primary productivity. In the case of CCRI data, this should be considered as an indicator of the presence of habitat but not its absence.

Deep waters, i.e., those waters off the continental shelf and slope, within the Canadian EEZ represent a vast expanse of ocean that remains relatively understudied and, as a result, undefined. Therefore, the distribution and diversity of deep-water habitats, such as abyssal plains, hydrothermal vents, methane hydrate and brine seeps, cold-water coral reefs, and deep-water canyons, and the biota they support are poorly inventoried for consideration in this analysis.

Localized studies (e.g., DFO Voisey's Bay Ecosystem Characterization Study; offshore Labrador biological reports; and other small-scale government and academic research studies), as well as historical data, are other potentially valuable sources of information for inclusion in processes to identify EBSAs. However, due to the vast expanse and diversity of information available in these categories, limited time and resources did not allow consideration of all of these during this particular process. However, as much of the information as possible was included in the initial identification and delineation of candidate EBSAs. Furthermore, expert knowledge was an important component of the peer review process.

Given the above, it is recognized that additional information may exist currently or in the future that could potentially identify more specific areas of significance within each of the EBSAs, refine the boundaries of the EBSAs, or result in the identification of additional EBSAs.

Data Processing and Management

Apart from the issues identified above, given that there was an abundance of data layers, many with a long time-series of data, using GIS techniques for much of the analysis, although requiring significant time and technical expertise, proved advantageous.

Ultimately, the specific databases created for the EBSA identification process can be considered "living" – ongoing time series existing in the database can be updated for subsequent review and new types of data can be incorporated into the database for inclusion in an EBSA evaluation. The resulting spatially referenced data layers are also archived and recoverable, for example, to facilitate comparisons over time, or to perform additional analysis.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 23-25, 2012 review on the Identification of Ecologically and Biologically Significant Areas (EBSAs) for the Newfoundland and Labrador Shelf Bioregion. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

DFO. 2004. Identification of Ecologically and Biologically Significant Areas. Can. Sci. Advis. Sec. Ecosystem Status Report 2004/006.

DFO. 2009. Science guidance on the development of networks of Marine Protected Areas (MPAs). Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/061.

DFO. 2011a. Ecologically and biologically significant areas - Lessons learned. Can. Sci. Adivs. Sec. Sci. Advis. Rep. 2011/049.

DFO. 2011b. Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/055:40 p.

Templeman ND. 2007. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas. Can. Sci. Advis. Sec. Res. Doc. 2007/052:iii + 15 p.

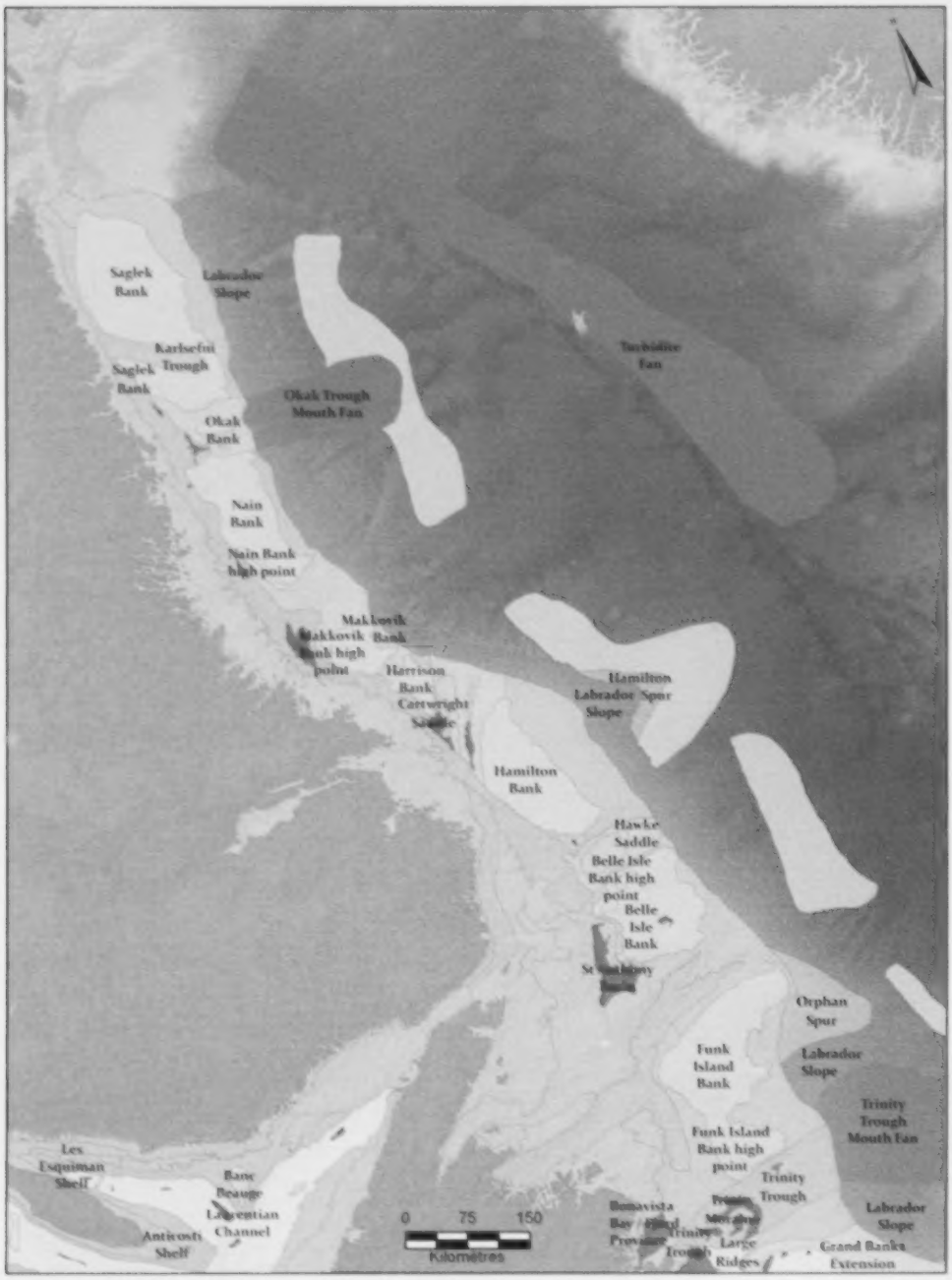
APPENDIX A: SUMMARY OF PHYSICAL, KEY BIOLOGICAL, AND OTHER BIOLOGICAL FEATURES FOUND IN EACH EBSA.

EBSA (NAFO Div)	Physical Features	Key Biological Features	Other Biological Features
COASTAL EBSAs			
Nain Area (2H)	Webb Bay, Tikkoatokak Bay, Nain Bay, Anaktalik Bay, Voisey Bay, Fraser River	Major colony of Thick-billed Murre Aggregations of several waterfowl and seabird species Common Eider colonies Seabird colonies Capelin spawning beach Highly productive area for Arctic Charr	High overall productivity in part due to unique aspects of the land-fast ice habitat Spawning salmon population Large congregations of Glaucous Gull 13 CCRI species
Lake Melville (2J)	Saltwater tidal extension of Hamilton Inlet; large fjord	Unique habitat (brackish waters) High productivity and species diversity Several freshwater, diadromous and marine fish species Salmonid spawning rivers and juvenile rearing areas Highest counts of moulting Surf Scoter in Eastern Canada High densities of breeding ringed seals	Numerous seasonal feeding aggregations of marine mammals
Gilbert Bay (2J)	Gilbert Bay, Alexis Bay; shallow-water, low-gradient, sub-arctic fjord	Genetically distinct resident population of Atlantic Cod	Important areas for Arctic Charr and Atlantic Salmon Capelin spawning area
COASTAL AND OFFSHORE EBSAs			
Northern Labrador (2G)	Inner, middle shelf, Saglek Bank; Cape Chidley to Saglek Bay	Unique migratory area for endangered Eastern Hudson Bay Belugas Important areas for Harlequin Duck and Barrow's Goldeneye (species of 'Special Concern' under *SARA*) Increasingly important summer/fall nearshore feeding habitat and migration corridor for polar bears Significant feeding and summer haul out area for ringed seals Important rearing and feeding areas for Arctic Charr	High winter concentrations of Common Eider Black Guillemot and Glaucous Gull colonies High densities of several seabird species Medium benthivores and plankpiscivores (Engel period) Juvenile Greenland Halibut (Campelen period)

EBSA (NAFO Div)	Physical Features	Key Biological Features	Other Biological Features
Hamilton Inlet (2H)	Coastal and inner shelf area outside of Hamilton Inlet, Sandwich Bay area	Capelin spawning beaches Highly productive areas for Atlantic Salmon Major colonies of Atlantic Puffin and Razorbill	Main area where harp seal whelping concentration usually forms Aggregations of several waterfowl species, including Harlequin Ducks (Species of 'Special Concern' under *SARA*) Important colonies of several seabird species High concentrations of many seabird species 23 CCRI species
Grey Islands (3K)	Hare Bay, Grey Islands, inner shelf southeast towards Fogo Island	High concentrations of a large diversity of waterfowl and seabird species, including Harlequin Duck (species of 'Special Concern' under *SARA*) Important colonies of several seabird species	Important coral concentrations Aggregations of Capelin (Campelen period) 25 CCRI species
Fogo Shelf (3K)	Bay of Exploits, North Twillingate Island, inner shelf area, Cape Freels, Fogo Shelf	Several beach and sub-tidal Capelin spawning areas Highly productive Atlantic Salmon areas Important area for several waterfowl and seabird species Largest Common Murre colony in the western North Atlantic Only breeding colony of Northern Gannet in the study area Important cetacean feeding area	Small benthivores (Campelen period) Male Hooded seals (Fall/winter) 36 CCRI Species
OFFSHORE EBSAs			
Outer Shelf Saglek Bank (2G)	Outer shelf of Saglek Bank, Labrador Slope	Important coral and sponge concentrations Feeding and migration area for several marine mammal species (whales and seals) Important aggregation area for several seabird species, including Ivory Gull (endangered under *SARA*)	Roundnose Grenadier (Engel period)
Outer Shelf Nain Bank (2H)	Outer shelf of Nain Bank, Labrador Slope	High diversity of species High concentrations of several coral species Aggregations of several fish functional groups Juvenile and female hooded seal aggregation area Aggregations of several seabird species, including Ivory Gull (endangered under *SARA*)	Juvenile American plaice (Campelen period) Harp seal summer feeding area

EBSA (NAFO Div)	Physical Features	Key Biological Features	Other Biological Features
Hopedale Saddle (2H)	Hopedale Saddle, Labrador Marginal Trough, Nain Bank High Point	Unique Eastern Hudson Bay Beluga overwintering area	High concentrations of several coral species Aggregations of several fish functional groups, core species and rare or endangered species Aggregations of several seabird species, including Ivory Gull (endangered under *SARA*) Harp seal summer feeding area Juvenile and female hooded seal aggregation area
Labrador Slope (2HJ)	Labrador Slope, outer shelf, Hamilton Spur	High diversity of species High concentrations of several coral and sponge species Aggregations of all fish functional groups, several core species and several rare or endangered species	Aggregations of several seabird species, including Ivory Gull (endangered under *SARA*) Female and juvenile hooded seal aggregation area
Labrador Marginal Trough (2J)	Cartwright Saddle, Labrador Marginal Trough, Hawke Saddle, inside Hamilton Bank	Aggregations of several core fish species Potential corridor for several species of fish and marine mammals Area of highest probability of use for harp seal whelping Harp seal summer feeding area Cetacean feeding/migration area	Aggregations of several rare or endangered fish species (Engel period) PlankPiscivores (Campelen period) Aggregations of several fish functional groups (Engel period) Female and juvenile hooded seal aggregation area Aggregations of several seabird species, including Ivory Gull (endangered under *SARA*)
Notre Dame Channel (3K)	Notre Dame Channel, Middle Shelf	High diversity of species Cetacean feeding/migration area Important area for Skates Aggregations of several core fish species	Aggregations of several seabird species, including Ivory Gull (endangered under *SARA*) Harp seal winter feeding area
Orphan Spur (3K)	Orphan Spur, outer shelf, Labrador Slope	High diversity of species High concentrations of several coral species Aggregations of several fish functional groups, core species and rare or endangered species	Female hooded seal aggregation area Aggregations of several seabird species

APPENDIX B: MAP OF UNDERWATER FEATURES IN THE NEWFOUNDLAND AND LABRADOR SHELVES BIOREGION STUDY AREA



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